SCIENCE NEWS-LETTER

The Weekly Summary of Current Science

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TESTING THE "LUNG"

Trapped Sub Crews to Have Fighting Chance

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Vol. XIV No. 898

Nobel Award May Start Controversy

Chemistry—Medicine

"Synthetic cod liver oil", stuff that builds bones and prevents the childhood disease of rickets without the unpleasant taste of the fish oil, was recognized when the 1928 Nobel Prize for chemistry was awarded to Dr. Adolf Windaus of Göttingen, Germany. This is the first time that the Nobel Prize Committee has recognized any of the scientific work done on the problems of human nutrition.

The work for which Dr. Windaus received the prize was the successful repetition of experiments proving that ultraviolet light, either in the sunlight or artificially produced, will activate the chemical called ergosterol and confer on it antirachitic properties. According to information available here the experiments were originally performed by Prof. George Barger of the University of Edinburgh. Dr. Windaus was so impressed by Dr. Barger's original results that he asked permission to collaborate with Barger in subsequent work on the problem. Windaus himself had been experimenting along similar lines without achieving definite results.

A scientific controversy may arise from this Nobel prize award since priority honors and patent rights are involved in the situation.

While the prize was awarded to Dr. Windaus, the subject of the antirachitic properties of foods has engaged the attention of scientific investigators both in this country and Europe for many years. The work along these lines began when Dr. E. V. McCollum and his associates at the Johns Hopkins University found that a substance, known as Vitamin D and found in cod liver oil and to a lesser extent in other fats, has the power of preventing rickets. These scientists also were the first to find that irradiating animals by exposing them to ultraviolet rays would keep the animals from having rickets even if the antirachitic vitamin D was not in their diet.

The next step was taken by Prof. Harry Steenbock of the University of Wisconsin, who, instead of irradiating animals, tried irradiating their food. He worked with a mixture of foods and found that irradiation gave to the foods the antirachitic power. Commercial production of irradiated foods is now in progress under the Steenbock patent. Dr. Alfred E. Hess of Columbia University irradiated the different classes of foods separately and found that the antirachitic substance was contained in fats. He and everyone else believed for some time that it was the cholesterol of fats that was the antirachitic substance.

Then in July, 1926, Dr. Barger and his associates in England announced that pure cholesterol cannot be activated by ultraviolet rays, but that irradiation does activate ergosterol which is found as an impurity in ordinary cholesterol not purified by a special process. They believed ergosterol had the antirachitic property. Dr. Windaus repeated their experiments, and again tested cholesterol which had been specially purified. He proved definitely that it is ergosterol and not cholesterol which is activated by exposure to ultraviolet light. Dr. Barger and his associate, Dr. T. A. Webster, have also proved by experiments with animals that this activated ergosterol can prevent rickets.

Pure science has scored over practical and applied science once more. The award of the Nobel Prize for chemistry for 1927 to Prof. Heinrich Wieland of Munich, Germany, is in recognition of experiments on the highly complex compounds known as the bile acids. Dr. Wieland has discovered the structure of the substance which gives bile its color, and has found the relation between this compound and chlorophyl, the coloring matter of green leaves, and hemoglobin, the coloring matter of blood. His work has no medical or practical significance at present and is of interest solely in the field of chemistry.

Science News-Letter, November 24, 1928

In This Issue—

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All of the resources of Science Service, with its staff of scientific writers and correspondents in centers of research throughout the world, are utilized in the editing of this magazine.

New Radio Device Helps Blind Landings

General Science

Following are reports of some of the more important papers presented before the autumn meeting of the National Academy of Sciences, at Schenectady, N. Y., November 19 to 21.

Airplanes may soon be able to land safely in a fog without the pilot seeing the landing field at all. This is one of the possibilities of a new radio altitude meter for airplanes developed by Dr. E. F. W. Alexanderson, of the General Electric Company, and described by him before the National Academy of Sciences.

The radio altitude gauge does the same thing for an airplane that the sonic depth finder does for a ship, he announced. With the aid of the latter, the captain can make a constant record of the depth of the water beneath him. He can not only avoid shallow water, but he can actually plot the contour of the ocean bottom and identify it with the contours given on his charts. It operates by sending a sound wave from an oscillator on the bottom of the ship. The wave travels to the bottom, is reflected upwards, and the difference between the time the sound is made and the time the echo returns permits an exact measurement of the depth.

Radio waves may be made to do the same thing for the airplane that the sound waves do for the ship, said Dr. Alexanderson, but since they travel at the speed of light and far faster than the sound waves through water, their use requires quite a different technique. The waves are sent out from a transmitter on the plane, part travel downwards to the ground. There they are reflected, and with the proper receiver they may be picked up again in the airplane. The time is too short to notice the difference, however, and an indirect method must be used.

The method consists in determining whether the returning wave is in step with the transmitted wave or not. If the height of the airplane is an exact number of wave-lengths above the ground, the two waves are in step. If the plane then goes higher or lower, or if the ground level itself becomes higher or lower, the two waves will be out of step. If the height above the ground changes more than a whole wave-length, the waves come into step again for a moment. If the airplane is equipped with apparatus for measuring the relation of the two waves, and the number of times they change, then the height of the plane above the ground can be measured.

In Dr. Alexanderson's device this is measured by the effect of the returning wave on the actual transmitter. This effect is to change the wave-length of the transmitted wave, and so it affects the strength of the returning wave. Thus by measuring this strength of the returning wave and the number of changes in step, the distance is determined.

Dr. Alexanderson also suggested a method of using two antennae with two oscillators of slightly different frequency. They could be arranged to give beats as the two sets of waves acted on each other, and could be arranged, for instance, to light a green lamp when the plane is 240 feet high and a red lamp at 80 feet.

"If these radio indications of height and position are combined with a mechanical landing device touching the ground at 10 to 15 feet," said Dr. Alexanderson, "it is conceivable, at least we are told so by our associates who are skilled aviators, that safe landings may be made in fog without any vision of the landing field."

Rays Trace Lamp Flicker

How a beam of cathode rays, tracing a luminous green line on a screen, can be used to study the flickering of electric lamps was described by Prof. Frederick Bedell, of Cornell University.

An electric incandescent lamp, lighted by alternating current, used in most cities, is constantly flickering. With 60-cycle current, commonly used, the lamp reaches its maximum candlepower a hundred and twenty times a second.

"The flicker is often of sufficient magnitude to be obvious to the casual observer," said Prof. Bedell. "A quick turn of the eye makes one conscious of it. Even when not obvious, the flicker is not infrequently a source of unconscious annoyance."

Previous methods of measuring this flicker have been indirect, and required many hours to determine the changes during a single alternation of the current. Now, with the use of the cathode ray oscilloscope, as the instrument is called, the light from the lamp being tested shines on a photoelectric cell. The cell gives a slight current, varying with the light. This is amplified, and it controls the path of the narrow pencil of cathode rays in the oscilloscope. As the rays strike a screen, it shines with a greenish light, and this light forms a curve that tells the exact variation of the brightness of the lamp. This curve can then either be traced or photographed.

Bombs of Gas Fall Into Sun

Bombs of gas, traveling at great speed, may fall into the sun, but not solid meteors. This was the surprising announcement made at the meeting of the Academy by Prof. Henry Norris Russell, astronomer of Princeton University.

Previously, astronomers assumed that solid meteorites could fall into the sun. Prof. Russell pointed out that the great heat of the sun would change them completely to gas as soon as they approached, unless they are more than two or three feet in diameter. However, the mass of gas would itself continue towards the sun with the same speed as if the meteor were solid.

Dr. Harlow Shapley, of Harvard, has estimated that 1,000,000,000 meteors strike the earth daily, and the Dutch astronomer, J. C. Kapteyn, has computed the total quantity of matter in a given volume of the universe. This has allowed Prof. Russell to calculate that the average mass of a meteorite is about two milligrams, or about one fourteen-thousandth of an ounce, which would make them microscopic in size. He suggested that the meteors we observe from the earth may be members of the solar system, and that they might be larger, but he thinks that few of these would hit the sun.

Because this amount of meteoric matter is so small, not more than about 60 tons a second would fall into the sun, a very small amount, considering the sun's great size. On this account, he said, the gas generated by the meteors would not be enough to account for some of the strange dark bands observed in spectrum photographs of the stars, which are suns, like ours, but much farther away.

First Milk Insures Calves

The first milk a cow produces after giving birth to her calf carries sickness-insurance against the ills that calf-flesh is heir to, and if the bovine infant is not allowed to have this milk it is very likely to become an item in the (*Turn to next page*)

Meeting of National Academy of Sciences—*Continued*

infant mortality statistics of the farmyard. So Dr. Theobald Smith, famous American bacteriologist, declared.

Many young mammals are protected for a time against various diseases by antibodies passed over into their bodies before birth from the blood of the mother. But against other diseases they are not given this protection, and it is these that the first milk, called the colostrum, wards off. Young calves not allowed to have this colostrum showed a mortality of 75 per cent., in Dr. Smith's observations.

The blood serum of the cow is only partly protective. The main agent of disease during the first few days of a calf's life is the colon bacillus. A serum prepared by injecting cows with these bacilli protects all calves against the early diseases, when the serum is fed in place of the first milk. But in about one-third of the calves so protected during the first few days of their lives, certain diseases may appear during their second month. This indicates that the colostrum is able to protect calves from diseases other than those caused by the colon bacillus, to which the protective action of the serum is limited.

Time an Element in Sex Control

Daphnia is a most peculiar female. She lives in an Adamless eden, and produces offspring as she pleases, without having to worry about a mate. If things go to suit her, she brings forth only daughters, thus insuring continued feminine domination of a pleasant world. But if the little cosmos she lives in—a puddle of stagnant water—becomes too crowded, or if it gets cold, or if chemical poisons intrude, then she produces sons as well; and if conditions are especially bad her offspring are nothing but males. This feminist among the lower animals apparently thinks that a world gone wrong is plenty good enough for the he-ones.

These facts about *Daphnia*, an almost microscopic relative of lobsters and shrimps, were discussed by Dr. Arthur B. Banta of the department of genetics, Carnegie Institution of Washington.

Why the sex of offspring, which in most animals seems to be a matter of internal control exercised by specialized protoplasm particles known as chromosomes, should in *Daphnia* be subject to the vagaries of environmental change, was discussed at some length by Dr. Banta. He pointed out that to be effective, these outside changes had to take place four hours before the eggs are laid. This coincides with a critical period in the rearrangement of the chromosomes, and points to the possibility that the environment determines sex not directly but only by working on the chromosomes. Should this later be demonstrated a fact, *Daphnia's* peculiar behavior would fall in with that of other animals.

Concerning the possibility of sex control in the higher animals, including man, Dr. Banta did not offer much encouragement. "Obviously, if sex is to be controlled in higher animals the sex-chromosomes must be taken into account," he said. "If it were possible to control the type of sperm, whether a female-determining or a male-determining sperm, which fertilized an egg the sex of the resulting individual might thereby be controlled. Unless and until such control is accomplished, sex control in higher animals seems beyond the possibility of attainment."

Dwarfs from Pieces of Eggs

It takes a whole egg to produce a chick or a duckling, but farther down the scale of life are animal eggs that can be broken up into pieces and each of the pieces will still be able to hatch, although the larvae developing from them will be dwarfs. So Prof. E. B. Wilson of Columbia University said. The animals on which most of the experiments have been performed are a kind of sea worm. The eggs are broken up by being whirled rapidly in a centrifuge, and the fragments then fertilized in the normal way. This capacity of pieces of eggs to develop as though they were whole ones, Prof. Wilson said, is evidence against the notion that eggs are permanently organized in advance of fertilization or the beginning of development.

Back in Cambrian geological time, so long ago that geologists refuse to estimate its age even in millions of years, the sea stood where the Penobscot River now finds its way across the rocks of Maine. The invasions of this ancient Cambrian sea are known from other parts of this continent, but the evidence for the ancient "wetness" of the oldest of dry states was presented for the first time by Prof. Edward S. C. Smith of Union College. Prof. Smith has discovered abundant fossils of an organism known as *Oldhamia occidens*, which seems to have been a kind of seaweed, in a thick series of folded slates and sandstones along the banks of the east branch of the Penobscot River.

Dam Upsets Salmon Travel

Capturing an entire salmon run and lifting the fish bodily over a dam which now obstructs their route toward the ancestral spawning grounds was the radical step advocated by Prof. Henry B. Ward of the University of Illinois.

Prof. Ward has for several years been making a study of the effects of a power dam across the Baker River, Oregon, on the annual run of the salmon. He found that the migrating fish tend to seek the coldest water, and since at this dam the coldest water issues from the powerhouse tailrace, the salmon exhaust themselves in useless attempts to swim up this torrent.

The construction of the dam has created a deep, cold lake which has captured some of the young salmon migrating downstream towards the ocean, and thus has produced a race that is physiologically landlocked. This race, however, is small and of no commercial value.

Plenty of milk, served early, is the secret of an apparently unlimited growth rate for a young animal. The falling-off in rate of growth that comes after a rapid initial spurt is due not to any internal factor or force, but simply to a limited food supply, Dr. F. Carleton MacDowell of the department of genetics, Carnegie Institution of Washington, told the Academy. Experimenting with young mice, he found that during the suckling stage the usual retardation in growth rate after the first week could be done away with by seeing that they got all the mouse milk they could drink, instead of the comparatively limited supply afforded by their mother.

Spiders Ride Hurricanes

The spiders of some of the islands of the West Indies have been long-distance aviators for many ages, according to Prof. Alexander Petrunkevitch of Yale University. And hurricanes have helped their flights instead of hindering them.

Prof. Petrunkevitch has been making a study of the distribution of spider species in the tropical American islands, and finds that in the western group, or Greater Antilles, they were (*Turn to page* 325)

Food, Oil, Gas From Coal

Chemistry—Engineering

Following are reports from the Second International Conference on Bituminous Coal, held at Pittsburgh, November 19 to 24.

Soap fats, edible fatty foods, lubricating oils, gasoline, kerosene, light and heavy oils, and anti-knock motor fuel of high value are among the commercial products that coal has been made to yield through the skill of the chemists of the German Dye Trust in their research laboratories and immense plants at Leuna, Ludwigshafen and Oppau in Germany.

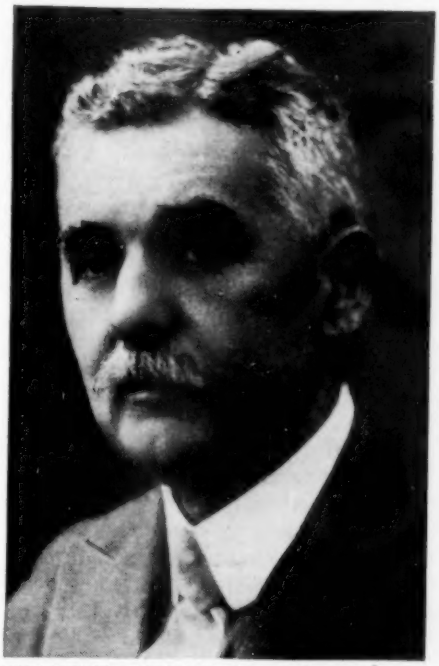
Seldom does information on their new chemical achievements emerge from the carefully guarded walls of this great industry, but before the Conference, Dr. Karl Krauch, director of the I. G. Farbenindustrie Aktiengesellschaft, discussed the mechanism of catalysis and hydrogenation, the chemical processes that have allowed the production of such diverse and valuable materials from coal as raw material.

The synthetic chemical production of basic materials from coal is of utmost importance to Germany's economic future. That country is made practically independent of parts of the world that have prospered from monopolies of rich natural resources. But the German research has immediate application to American conditions. The president of the Standard Oil Company of New Jersey, Walter C. Teagle, introduced Dr. Krauch and in his address the German chemist revealed that the Dye Trust processes, controlled in America by the Standard Oil Company, can be used effectively in the refining of crude oil.

Catalysis Banishes Sulphur

Refined by the catalytic process, crude Mexican oil, containing 5 per cent. of sulphur, produces gasoline with only a small amount of this undesirable element. Catalysis and hydrogenation also allow the refinery to make from crude oil the material bringing the highest market price. Gasoline, kerosene, gas oil, lubricants and other products can be produced in quantities varying with the catalysts used. Research applying these new German developments to American refinery practice is understood to be underway in Baton Rouge, La.

At the Leuna chemical plant in Germany, an annual production of 70,000 tons of synthetic gasoline has been achieved and by the end of 1929 it will equal 250,000 tons. The processes used in this and the other



GEORGES CLAUDE froze air; made ammonia—now he seeks power at the bottom of the sea

synthetic productions are combinations of catalytic methods developed by the I. G. chemists and the hydrogenation methods developed by Dr. Friedrich Bergius, the German chemist, whose patents were acquired last year by the German Dye Trust.

The close resemblance that synthetic gasoline and other products obtained in the hydrogenation of coal bear to their natural counterparts suggests to Dr. Krauch a new theory of the origin of crude oil.

"Peat and coal layers, after getting into greater depths, combine with hydrogen under pressure, thereby being partially converted in liquid hydrocarbons," said Dr. Krauch. "The presence of hydrogen in the interior of the earth is deduced from the fact that both rocks and volcanic gases contain it. Apart from the generally accepted views of its formation, its origin might be attributable also to the action of water vapors at high temperature upon coal."

The basis of catalysis, the chemical phenomenon that causes two substances to react more effectively in the presence of another that does not undergo chemical change, is believed by Dr. Krauch to be electromagnetic. He conceives the molecules and atoms as having two poles like a bar magnet. The catalytic agent places them under an electric spell and makes them more receptive to chemical action.

Credit was given by Dr. Krauch to American chemists for the fundamental theoretical research upon catalysis. Discoveries by chemists of this country were often used in making the industrial application in Germany.

Water In Fuels of Future

Setting the Thames afire is one of the proverbial impossibilities; yet the householders and factory owners of the future will be doing exactly that when they light up the fluid fuel in their furnaces.

This in effect was the prophecy of A. T. Stuart, consulting engineer of Toronto, uttered before the Conference. He based his look ahead on the ever-increasing use of liquid and gas fuels in industrial and domestic power and heating plants, and on the increasingly practicable processes for converting coal and other solid fuels into fluid forms.

The essential of making coal into a liquid or gas fuel without waste is the adding of hydrogen to its carbon. Hydrogen is obtained commercially by breaking up water with electricity. Hence, said Mr. Stuart, "it is not unlikely that more water than coal will be used as raw material and that perhaps half of the energy of future fuel will come from the combustion of hydrogen obtained originally from water."

Water yields oxygen as well as hydrogen when it is broken up, and the disposal of the surplus of oxygen will present considerable engineering problems, Mr. Stuart continued. Some oxygen can be combined in the fuel-making process, but a great deal will be left over. The best disposal of this, he believes, will be to find some place in the process where it can be separated out, and dispose of it as a commercial gas.

Water power sites and coal mines will not be looked upon as rivals when the fluid fuel economy of the future has been worked out. The most efficient means for breaking up the water to get its combustible hydrogen is to be found in the electricity generated by hydroelectric plants, which already have far higher capacity than the market justifies. This is because their market at present makes use of their maximum production during only a part of each day—the so-called "peak- (*Turn to next page*)

International Coal Conference—*Continued*

load" period. But if the power can be used for the generation of hydrogen and oxygen from water during the slack periods, the plants can be run at full efficiency continuously; and what was originally water power will appear, sometimes at long distances, as fuel power.

"Coal Improvement"

"Coal improvement" plants—industrial developments for pulverizing, carbonizing, liquefying or otherwise increasing the fuel value of coal—are likely to pay the investor better than electric power plants. This was the thesis set forth by F. zur Nedden, Secretary of the Fuel Committee of the National Fuel Council, of Berlin.

Herr zur Nedden has made a study of the economics of fuel and power production in Europe, and is convinced that "the higher the quality of the bearer of energy into which you transform coal the greater is the amount of capital which you must invest per ton of annual throughput." The lower costs of coal improvement plants as compared with electric power plants are in accordance with this generalization, he declares.

While his studies apply mainly to European conditions, Herr zur Nedden feels that even in America, where power investors are "wading in oil", certain attractions may be found in coal improvement plants: "As the supply of energy in all its various forms, which are constantly becoming more refined, is the basis of modern civilization and industry, it always requires long-term foresight so that the building of plants for the improvement of coal is more or less a matter independent of the fluctuations of business trends. This kind of investment, therefore, acts as a *stabilizer* ironing out the fluctuations in the occupation of industry and labor."

Coke Used in Homes

Coke may become an important fuel for home use with the aid of a new boiler described by Dr. Charles W. Brabbée, director of the Institute of Thermal Research at Yonkers, N. Y.

The coke is supplied to the grate from a large water-cooled magazine, which holds enough fuel to keep it going for eight hours at greatest heat. In ordinary winter weather, and in the average home, said Dr. Brabbée, it should not require attention more than twice a day.

One important outcome of the use of such a boiler will be in the use of large supplies of coke, which are coming into the market as a result of the increasing consumption of gas. The coke is a byproduct in the manufacture of gas from coal.

Half Ton to Start Train

It takes half a ton of coal to start a freight train and bring it to running speed, W. L. Robinson, superintendent of fuel and locomotive performance of the Baltimore and Ohio Railroad, told members of the Conference. On that account it is important to eliminate unnecessary stops.

He also emphasized the importance of keeping impurities out of the coal.

"A difference of only one per cent. between the ash content of prepared seam sample and shipment sample is of such ordinary occurrence as to attract only casual notice" he said, "but let us illustrate the importance of this variation to our railroads alone, as coal consumers. One per cent. is equivalent to 20 pounds per ton. Our railroads use in round numbers 125 million tons of coal per year. Twenty pounds of extraneous material in each ton of this annual consumption amounts to one million and a quarter tons which, if loaded into 25 thousand 50-ton capacity coal cars, would make up 213 trains each a mile long. End to end the cars would reach from Pittsburgh to Cleveland and 65 miles beyond.

"This waste material is not only paid for at the average price of the fuel but is hauled to consumption points loaded onto tenders where it imposes a further handicap upon combustion efficiency and fuel economy, and finally has to be hauled away from ash pits, a total loss from beginning to end."

Seeks Power From Sea

An engineer working on an invention that will not be any good until a couple of centuries after he is dead, but will be urgently needed then—such was the phenomenon which was presented by Georges Claude, noted French worker on gases, in his appearance before the Conference. And M. Claude was not directly concerned with coal at all, but with what the world will do for power after the coal is all burned.

He proposes to harness the potential power involved in the difference between surface and bottom temperatures in the sea. The array of eminent chemists, engineers, inventors and industrialists who heard his address listened with respect, because the speaker's record was not that of a mere visionary. M. Claude invented the first successful process for making liquid air and liquefying other gases; he pioneered in the field of making ammonia out of the atmosphere; he is the inventor of the glowing neon lights that shine on our street signs at night.

The difference between surface and bottom temperatures in the sea, which M. Claude proposes to turn into kinetic energy, is not great. Bottom temperatures hover near the freezing point of water; surface temperatures are only thirty or forty degrees above them. This is only a fraction of the temperature difference utilized in the ordinary steam plant, where the degrees are counted by hundreds instead of by tens. The French inventor proposes, however, to get around this by exhausting the air from his boiler. In the vacuum thus created water will boil at very low temperatures, provided the vapor thus generated is removed fast enough and condensed after being passed through a turbine. A working model of such a hydrothermal plant has been built by M. Claude and his associates, which has been successfully demonstrated before a number of scientific bodies in both Europe and America.

Science News-Letter, November 24, 1928

"Lung" to Prevent Submarine Disasters

Navigation—Invention

By James Nevin Miller

When the S-4 sank a few months ago, causing one of the greatest submarine tragedies of modern times, Navy officials gathered together and decided that drastic steps must be taken soon to restore the prestige of America with respect to making our undersea craft as safe for human beings as possible.

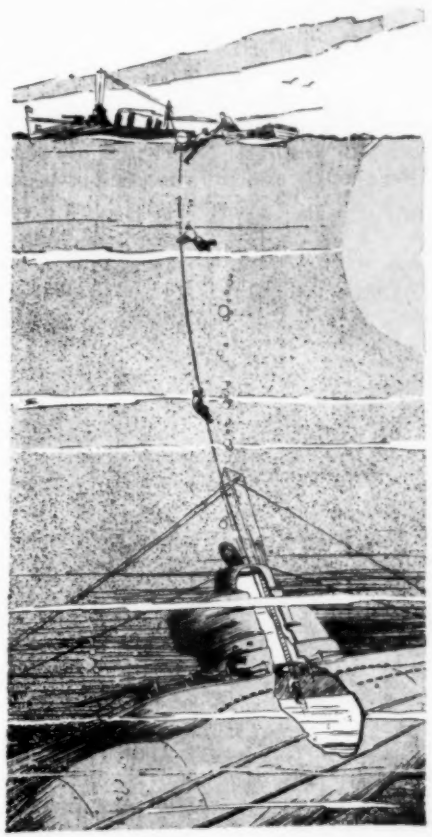
Now it seems that the efforts of the experts have not been in vain. Announcement has just been made that the disabled S-4 has been recommissioned and will be put into service again for the purpose of making final tests on a new device that promises to revolutionize completely the present measures for saving the lives of men submerged in sunken submarines.

The invention is an oxygen helmet resembling a cross between a gas mask and a gunny sack. For lack of a better name it has been christened temporarily the "Lung" and it is expected that after a short while of perfecting the device it will be used as a regulation part of standard American submarine equipment.

In days gone by the accepted rescue procedure in time of submarine accident has been to send divers down to the wrecked craft to size up the situation, meantime dividing their attention between endeavoring to save the lives of the crew and attempting to lift the submarine to the surface. All too many times the result has been that such division of purpose has been non-productive of the best kind of results. Either the craft was not salvaged in efficient fashion, or else members of the submarine crew were forced to undergo undue hardships, some dying, perhaps, who should have survived.

With the use of the "Lung", however, the procedure may assume an entirely different turn. Salvage and rescue operations need not interfere with each other to the slightest degree, for the new device enables the submarine crew to rescue themselves. Weighing but two pounds and requiring only a few seconds to put on, it is worn with bathing suit or ordinary light clothing—a welcome contrast to certain standard European types of rescue apparatus whose average weight is around 21 to 26 pounds and which require a good while to adjust and put on.

The inventors of the "Lung" are three of the most up-and-coming young men in the Navy—Lieut. C. B. Momsen, Chief Gunner C. L. Tibbals and F. M. Hobson, civilian engineer in the Naval Bureau of Construction and Repairs. Momsen is a typical product of the Naval Academy, a well set-up, athletically disposed youth on the safe side of thirty, whose unfailing rule is to try out devices of his own invention on himself rather than risk the lives of others with them. Tibbals needs no introduction to the American public. Although young in years, he is old in point of experience, having tried out probably every recent life-saving invention devised by submarine experts. One of his latest achievements was to help supervise the diving procedure at the time of the S-4 tragedy. Under the most severe and unflagging criticism of the nation's press he carried on in such fashion as to further strengthen his already enviable record. Hobson is a quiet, modest young man whose technical ability is ranked with that of the best-known submarine experts in the country.



HOW SUBMARINE CREWS, wearing the newly invented "lung" will escape to the surface should another S-4 disaster be threatened

For more than six months both Momsen and Tibbals have been making exhaustive tests with the "Lung", first of all in a tank located indoors at the submarine school in the Washington Navy Yard. The water there is crystal clear, giving excellent opportunity for experimentation under close observation of other experts. While the tank is small, only 60 feet deep, it is so constructed that pressure conditions may be applied that are equal to those prevailing at a depth of 300 feet—as far down as the submarine ordinarily dives. On one occasion the venturesome Tibbals remained in the tank while such a pressure was brought about. Not the slightest discomfort did he suffer, a definite indication that the device was worth a trial in the out-of-doors waters, where the diver would have to feel his way more or less blindly around the bottom.

The next procedure was to try out the device in the lower waters of the flood-swept Potomac River, not far from Washington. Clad only in bathing suits and the "Lung", the two men descended slowly into a regulation diving lock fastened by block and tackle to the stern of the experimental boat, "Crilley." Thereupon the men on deck lowered the block to the river bottom, all the while blowing more air pressure into the lock. When the bottom was reached the men above released a small cork lifebuoy, such as is used ordinarily to sustain a diver's weight in the water.

Just now the purpose of the two men was to test the facility of a diver's ascent with the aid of the "Lung". Wherefore, slipping out of the lock, they began, one after the other, to climb the life line attached to the buoy which bobbed along the surface. Certainly their climb was rapid—the buoyancy of their oxygen bags tended to make them well-nigh hurtle through the water, though they were well able, by merely grasping the line, to regulate their ascent as they chose. None the worse for their experience, the two experts and other divers made the tests many times, ultimately going down as deep as 110 feet. Thereafter, a few days later, they were able to go down some 10 feet further.

The inventors laughingly admit that the "Lung" is pretty much the product of frequent invasions into various and sundry (*Turn to next page*)

"Lung" to Prevent Submarine Disasters—*Continued*

scrap heaps. Indeed, were it not for certain intricate valves, whose secrets are known only by the three experts, and the fact that the device's only face covering is a mouthpiece clipped tightly over the lips, one might well suppose that it is a sort of crude gas mask. The tubing is of the gas-mask type of material, the breathing valve is from an old automobile tire, the rubber hose is like that used in the making of siphons, and there is a tiny canister containing soda lime. This chemical works very much like those used in some of the heavier European "safety devices", serving to purify the carbon dioxide continually being exhaled by the wearer. The oxygen bag and the rubber mouthpiece are connected by means of two tubes.

Chief Gunner Tibbals brings out some highly interesting facts about the intended use of the new apparatus under actual rescue conditions. Says he:

"If we briefly review what happened to the S-4 not long ago we perhaps can understand the precise purpose of the 'Lung'. As almost everyone knows, most submarines are divided into five water-tight compartments—the control room, the battery room, torpedo room, motor room and engine room. Moreover, every bulkhead is provided with hinged doors containing heavy 'dogs' that serve to keep them closed tightly.

"Now, the ramming of the S-4 by the Paulding produced only a relatively small hole in the battery room. Of course, the water tended to come rushing in at a fairly fast rate. But nevertheless the members of the crew were able to close the door at the forward end of the battery room, whereas the men in the control room were able also to shut the after door of the compartment. Under such circumstances there is every reason to suppose that the rest of the submarine should have remained dry, since the damaged compartment was thus exceedingly well isolated.

"Take note, however, of what actually happened: Lieutenant Commander Jones, looking after the control room, was forced to leave his station because chlorine gas was leaking in through the forward bulkhead, and seek safety aft, where he and his crew managed to close the door leading to the control room.

"Had Commander Jones been able to remain in the control room the S-4 tragedy might have been averted. No doubt he would have been able to feed air from the compressed air tanks to his crew, and thereafter to pass his 33 men one by one through the escape hatch to the ocean's bottom where divers were on hand to help them gain the surface.

"But the men did not have access to that life-preserving store of air—which point serves to illustrate how the 'Lung' might have saved the situation. Not only the control room, but every submarine compartment as well has an escape hatch, so that if a 'Lung' had been conveniently at hand, one for each man, the hatch where the men were imprisoned should have been emptied of its human cargo in short order."

Chief Gunner Tibbals explains how it is that men wearing the "Lung" will be able to combat the great pressure conditions that exist down around 200 feet below the surface: "Normally the human body is under a pressure of about 14.7 pounds. At 200 feet it is around 88 pounds. However, we must bear in mind that pressure conditions are relative. Which is to say that they are distributed equally throughout all parts of the body. Nor should the fact be forgotten that men in an entrapped submarine have had a few moments at least whereby to get used to the new pressure conditions.

"But probably the most important point is that the men do not remain very long in the water once they have donned the 'Lung'. The buoyancy of the oxygen container, plus that of their bodies, tends to hurtle them to the surface in time to avoid serious injury to the ear drums due to the terrific pressure."

Science News-Letter, November 24, 1928

World Will Feed on Converted Wood

Chemistry

By Friedrich Bergius

Dr. Bergius, now visiting this country, is the inventor of the process being used in Germany to produce annually 100,000 tons of synthetic gasoline from lignite or coal. He is now developing a method for making wood edible. Turning waste cornstalks into glucose sugar is another possibility his work suggests.

Carbohydrates, taken directly or indirectly, whether by human beings or animals, are essential for nutrition. They represent a concentrated product of the energy of the sun. After undergoing certain changes they serve, as fuel, to produce the various kinds of energy which sustain life. In plant-life nature produces carbohydrates in different forms, some of them being directly serviceable for digestion on the part of most animals, others fit for use only by innumerable sorts of so-called lower organisms, especially by microbes.

The various carbohydrates differ only very little among themselves as regards their elementary composition, but these small differences divide them into two classes, by reason of their vastly different mercantile value.

Agriculture, by gradual development in the course of thousands of years, has produced in very large quantities a rather small number of species containing carbohydrates in such form as makes them available for use as food for human beings or for cattle. Nature produces still larger quantities of carbohydrates which are digestible as such only in small part in the stomachs of men and beasts. Their main representative is the woodpulp which is contained to a very large percentage in the waste products of agriculture, especially in wood. Immense quantities of such waste products are at disposal, in this country especially, in form of corn stalks. A considerable part of such waste wood, as we know, is not used in an economical way. In producing lumber, at least 40 per cent of the wood falls off as waste, being used either not at all or, at best, as fuel. Burning up wood means destruction of cellulose, that inner chemical substance of wood, so valuable commercially.

FRIEDRICH BERGIUS turned coal into oil; now he is getting food out of wood

The present enormous request for print paper steadily diminishes our stock of wood in the present, while seriously endangering our future supply. A possibility of turning the forest waste into human nutriment or fodder for cattle might considerably influence agricultural and forest policies in vast territories of the world.

In the course of such reflections the question arises whether it might not be possible for chemistry slightly to alter the cellulose molecule so as to bring it into (*Turn to next page*)

Chemistry Alters International Relations

Chemistry

By Edwin E. Slosson

When I speak of the new field of chemical industry as the Synthetic Kingdom I have in mind something more than the mere fact that it consists in making new combinations of the chemical elements. It also makes new combinations of industries and brings together different countries as well as chemical elements. As the Synthetic Kingdom over-rides the traditional dividing lines between animal, mineral and vegetable, so also it overrides the traditional lines between the nations. It brings international competition which naturally results in the end in international cooperation. This modern development of chemistry has strong political consequences. It promotes national independence and at the same time breaks down natural monopoly.

Twenty years ago it could be said that Chile had a natural monopoly of the world supply of nitrates but the monopoly has been broken in two ways; by the utilization of the nitrogen from coal through the preservation of its by-products, and by the utilization of the nitrogen of the air through fixation. An impartial Providence has endowed every nation with a supply of nitrogen exactly proportional to its area. Whether this free nitrogen is utilized or not in any particular country depends not upon natural resources but the ability of its people. Brain power, like water power and coal power, is very unevenly distributed among the nations.

The effect of the synthetic regime in short circuiting natural processes and multiplying the resources of raw materials has brought industries and countries into unexpected competition. The chemist has upset the geography that we learned in school. For when we were children the natural products were duly distributed among various countries by what was assumed to be the immutable law of nature. To impress this upon our youthful minds we had pictorial maps showing the sources of the substances that were consumed in our daily life; a rubber tree in Brazil; an indigo plant in India; a cotton plant in Carolina; a camphor shrub in Japan; and a silkworm in China. The chemist has ruthlessly uprooted these neat emblematic labels. The United States may ship indigo to India. If the motion picture magnate finds that Japan is charging him too much for the camphor for his films he may buy it from Germany where it is made from American turpentine. The silk worm of Japan and the cotton plant of Carolina are hard pushed by the competition of the wood pulp of Sweden.

The new synthetic kingdom of which the chemist is king and founder already overlaps and may ultimately embrace the three traditional kingdoms of Nature. In the present transition state, while the new regime is being established, the attempt to classify products according to the old divisions is causing considerable confusion. Does a given sample of butter come from (*Turn to next page*)

World Will Feed on Converted Wood—*Continued*

such form that it may act in the stomach just like digestible carbohydrates of starch or of sugar. This can indeed be accomplished by merely adding one molecule of water to one molecule of cellulose—a simple chemical reaction which has been known for more than a century. Nevertheless, well known insignificant chemical reactions, easily produced in the laboratory, sometimes involve enormous difficulties when it comes to putting them to test on a technical scale and at the same time on an economic basis.

A number of processes to realize chemically the reactions of hydrolysing woodpulp have been developed in the course of time, the first practical application having been carried through many years ago, right here in this country, near Chicago. The aim of all these processes has been to transform woodpulp into a fermentable product, to be used in the manufacture of alcohol. All these methods have failed economically until now, because they have not yielded enough fermentable stuff.

While the production of alcohol has been the ultimate goal of all these processes of hydrolysing woodpulp at high temperature, the transformation of woodpulp into foodstuffs has become the aim of a new technical method developed during the last twelve years under my supervision.

In Germany some fifteen years ago Willstätter found by the action of highly concentrated hydrochloric acid that woodpulp could be almost quantitively transformed into soluble carbohydrates and finally into glucose. On the basis of these laboratory results we worked out my process allowing a yield from every hundred parts of any dry wood about 75 parts of crude foodstuffs, containing 80 per cent. of pure carbohydrates. That means 60 per cent. of pure carbohydrates is obtained from the dry wood. This product proved to be of high nutritive value and equal to any other foodstuff of like starch concentration and particularly adaptable to the raising of pigs. Successful experiments have been made to transform the primary product, glucose, for nourishing human beings. We have succeeded in evolving a simple cleansing process for this purpose and have produced pure glucose.

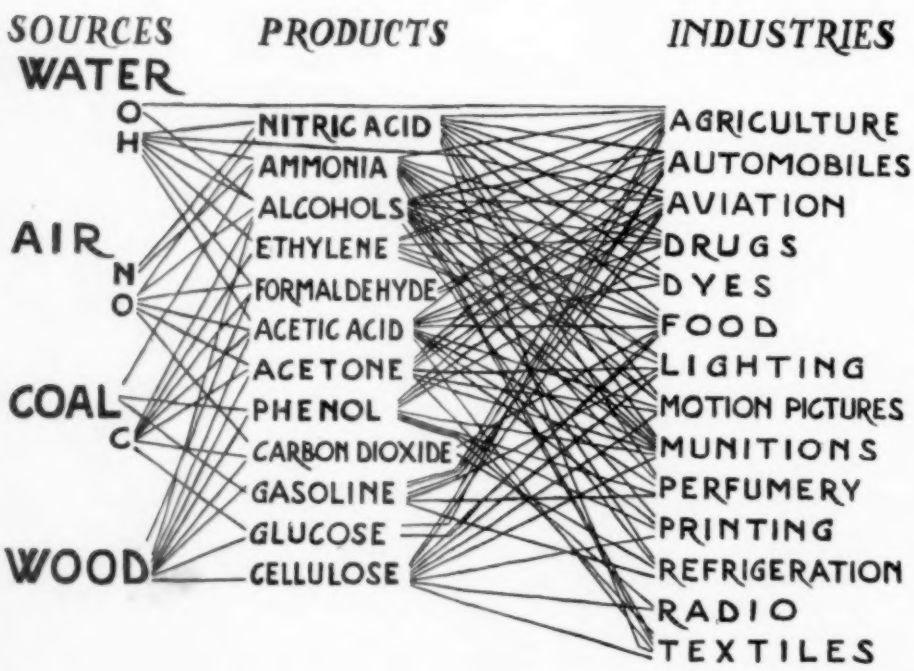
Considerable difficulties had to be overcome during the twelve years of development of the technical methods and apparatus. The most difficult problem has been the separation and recovery of the highly concentrated hydrochloric acid, while no less serious and hard work on the part of a rather large staff of chemists, engineers and workmen had to be done to find the most practicable way of handling the wood, preventing leakages of hydrochloric acid vapors, constructing acid-proof vessels and attending to many other details. Rather large amounts of capital had to be invested before an initial technical plant could be operated without difficulties.

In Germany, which is not producing sufficient agricultural carbohydrates for cattle food and which has a rather large supply of waste wood, this new industry may become an important factor in its economics. But it may also prove useful to the United States where the problem of disposing of the waste material in the cornfields, for instance, begins to be a serious question on account of the increasingly destructive activity of the cornborer.

Obviously, the particularly technical problems in every country have to be studied separately and there is no denying the fact that it takes perseverance, faith and a good deal of optimism, not to speak of time, for preparing and developing a new industry of that kind.

Science News-Letter, November 24, 1928

Chemistry Alters International Relations—*Continued*



HOW THE RAW MATERIALS for our industries come from unexpected sources

a cow or a cocoanut? Does a given sample of sugar come from beet or cane? Does a given sample of alcohol come from grain or wine? Does a given sample of acetic acid come from cider or malt? Does a given sample of rubber come from forest or plantation? Does a given sample of musk come from seeds of hibiscus or glands of deer? Perhaps neither; for, perchance the butter and sugar, the alcohol and the vinegar, and the rubber and the perfume may have come from coal. Nobody knows but the chemist who made it and maybe he won't tell. Anyhow, it's nobody's business if the chemist has done his business well enough so the product is correct. After a compound has come under the domain of the chemist, it has renounced all allegiance to the kingdom of its natural origin.

Science News-Letter, November 24, 1928

There are about 500 species of fleas, but less than a dozen seriously pester men and domestic animals.

National Academy—*Cont'd*

apparently pedestrians, crossing from the South American mainland over a land connection long since sunk into the sea. Along the Greater Antilles to the east, however, they give evidence of having traveled by air, the lines of distribution lying approximately in the direction of the most frequent hurricanes.

Racial Mental Differences

"We are driven to the conclusion that there is a constitutional, hereditary, genetical basis for the differences between the two races in mental tests."

This was the conclusion resulting from a series of mental tests of whites, Negroes and mixed bloods in Jamaica, conducted by Dr. C. B. Davenport of the department of genetics, Carnegie Institution of Washington.

Groups of individuals of the two races and their crosses, all of approximately the same social and educational levels, were given mental tests for aptitudes in a number of different fields. In some, the whites showed very definite superiority. These included tests intended to bring out capacity to size up a situation, use common sense on it, reason it out.

But the results were by no means one-sided. The Negroes beat the whites in certain memory tests. In musical aptitudes there was more or less of a stand-off: the score of the white race was higher where a sense of harmony was being tested, but in the more elementary matters of pitch and rhythm the Negroes were more acute.

Locates Nucleus of Universe

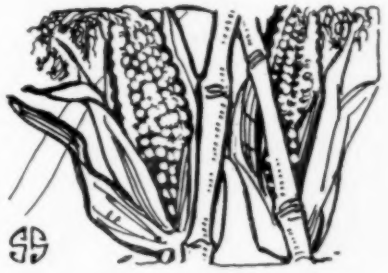
The nucleus of our "universe"—the galaxy of stars of which the sun, the Milky Way and all the other stars that we can see are part, has now been located. This discovery has been made by Dr. Harlow Shapley, director of the Harvard College Observatory.

This nucleus is in the same direction as the constellations of Sobieski's Shield, Ophiuchus, Sagittarius, Scorpion, the Southern Crown, the Altar, the Rule, and the Centaur. The latter four are all groups that can only be seen from the southern hemisphere of the earth. As we see it, the nucleus extends for about fifty degrees along the Milky Way, in these constellations. Its distance from us is about 47,000 light years. A single light year, which is the distance that a (*Turn to next page*)

NATURE RAMBLINGS

By Frank Thone

Natural History



Corn

The Thanksgiving Day table offers up a great variety of things native to America: the turkey and its accompanying cranberry sauce; white potatoes, sweet potatoes, tomatoes, squash, pumpkin and a postprandium of pecans, peanuts, Brazil nuts, black walnuts, chocolates and tobacco.

But of all the gifts which the primitive Indian agriculturists presented the European settlers—or which aforesaid settlers took from them without thanks—the greatest has been corn. Corn probably originated in the South American highlands but by the time the white men came its cultivation had spread as far north on this continent as the climate would permit, so that from Columbus onward every European comer met it. Chance caches left by the Pequots and not too conscientiously acquired by the Pilgrims saved Plymouth Colony more than once during the terrible first winter of 1621.

So completely did this new grain come to dominate the agriculture of the new settlements that it appropriated a name from the English language, just as the speakers thereof had appropriated it and the land whereon they raised it from the original owners. In seventeenth-century English, "corn" was a collective name for all kinds of grain—wheat, barley, rye, and all the rest—and that is what a Britisher still means when he says "corn." When he talks about our corn he calls it maize. The first settlers began by distinguishing the aboriginal grain as "Indian corn," but presently, with typical New England thrift of words, they simply called it corn. Another mark of dominance of maize in American agriculture is our new name, "small grains," for what our British cousins call "corn."

Radio to Moon?

Physics

Radio communication with the moon is not impossible after all. At least, it would be possible if there were people there to receive the messages. Radio waves can actually leave the earth, for at least a million miles. They are not completely stopped by the Kennelly-Heaviside layer, which has been supposed to act as an opaque screen to the waves.

This announcement is made by Dr. Carl Stormer, famous Norwegian physicist, in a communication to *Nature*, the English science journal. He has found that radio waves of about 31 meters length may give echoes that return as long as 15 seconds after transmission. Radio engineers have frequently observed an echo after about a seventh of a second, due to the waves traveling around the earth. They have also detected the return wave, reflected from the Kennelly-Heaviside layer. The newly observed echo, however, takes so much longer that it can not be due to either of these causes.

The long echo was first noticed by an Oslo radio engineer, Jorgen Hals. He communicated (*Turn to next page*)

Fight "Monkey Law"

Evolution

Arkansas courts must decide whether Arkansas schoolrooms shall continue to have dictionaries and encyclopedias in them, is the opinion of J. P. Womack, State Superintendent of Public Instruction. He holds that if the law should be interpreted as meaning that a reference book is a textbook, then even dictionaries must go. But a court decision will be necessary to decide the point, and in the meantime the reference books stay.

This raises a dilemma for the Arkansas schools. Offending textbooks may be removed promptly, and the lips of teachers sealed on penalty of loss of their jobs and a stiff fine, but in the meantime, easily accessible to every curious youngster, there remain the encyclopedias, all of which contain articles on evolution.

A legal test of the new statute may be initiated in the near future. A committee of leading citizens of Arkansas who oppose the law are now in correspondence with the University of Arkansas chapter of the American Association of University Professors, and their decision as to appropriate action is expected daily.

The passage of the Arkansas anti-evolution law (*Turn to next page*)

Radio to Moon—*Cont'd*

his results to Dr. Stormer, who then arranged for special signals from the large radio station of the Philips lamp works at Eindhoven, Holland. Dr. Stormer himself heard echoes from these at intervals of from 3 to 15 seconds after transmission. His observations were verified by Dr. van der Pol at Eindhoven.

The speed of radio waves is well known; it is the same as that of light, 186,000 miles a second. In 15 seconds, therefore, the radio waves have traveled at least a million miles away and back. This is about four times the distance to the moon.

Dr. Stormer thinks that the echoes are caused by a layer of electrons which come from outside the earth, particularly from the sun. The magnetic field of the earth deviates them, so that they form a vast hood around the earth, but reaching the earth near both magnetic poles. Within it there are no electrons. The radio waves travel out to this hood, far beyond the moon, and then are reflected back, he thinks. Whether or not some may even penetrate the electron layer, and actually travel to the other planets cannot now be determined.

Science News-Letter, November 24, 1928

"Monkey Law"—*Cont'd*

will be the signal for a stiff fight by the American Association of University Professors for the right of their colleagues to teach science according to the laws of nature rather than according to the dictates of the anti-scientific forces of Southern rural districts. This was indicated by Prof. A. O. Lovejoy of the Johns Hopkins University, prominent in the councils of the Association.

"We did not take part in the pre-election fight over this law," said Prof. Lovejoy, "because we knew that the people in Arkansas would be sensitive and resentful about outside interference. But now that it is on the books it can be attacked—and we think successfully—on constitutional grounds. The American Association of University Professors will probably take action at an early date."

Science News-Letter, November 24, 1928

Tokyo has set aside parts of 200 streets for children to play in after school hours.

A method of putting out fires by freezing the flames with solid carbon dioxide at 100 degrees below zero has recently been devised.

National Academy—*Cont'd*

beam of light will traverse in a year, measures about 6,000,000,000,000

Next to the galaxy itself, or the other galaxies which we see as spiral nebulae, it is the hugest thing ever measured by man. It extends for about 29,000 light years in the direction in which we look at it, and is about 16,000 light years thick. The center is in the constellation of Sagittarius, the archer, a group that is now low in the western sky just after sunset. Some years ago Dr. Shapley found that this region was the center of a supersystem of the globular clusters of stars that appear in various parts of the sky.

"Apparently," said Dr. Shapley, "our entire Galaxy rotates about this nucleus."

The method by which he found the nucleus and measured its distance was with the use of the changes in light in many variable stars. These particular stars, known as Cepheid variables, change their light in a peculiar way, from which the astronomer can calculate their distance. Another type of variable star, known as the long period variables, was also employed.

In proving the existence of this nucleus, Dr. Shapley has furnished a new proof of the similarity of the Galaxy, or "universe" of stars in which we live, to the spiral nebulae. Thousands of these are known, and were shown several years ago, by Dr. Edwin P. Hubble, of the Mt. Wilson Observatory, to be stellar systems beyond the limits of our own. As a nucleus is a characteristic feature of these nebulae, and as they apparently rotate around them, it now appears more certain than ever that we actually live in a spiral nebula.

Are new mountains beginning to grow along the Atlantic seaboard of America?

At least slight indications that such may be the case were called to the attention of the Academy by M. R. Campbell of the U. S. Geological Survey. Mr. Campbell has made a study of geologically recent gravel deposits on the old river terraces on the Potomac, Susquehanna and Schuylkill rivers, and has found them bent upwards at three different places. The arching is not great, but it is sufficient to indicate upfoldings in the deeper layers of the earth, taking place long after the mountain-building movements that gave rise to the Appalachian system.

Science News-Letter, November 24, 1928

FIRST GLANCES AT NEW BOOKS

AMATEUR TELESCOPE MAKING—Albert G. Ingalls and others—*Scientific American* ($3). A few years ago the *Scientific American* published a series of articles on how the amateur could make reflecting telescopes, later issuing a little book on the subject The rapid depletion of this edition, and the springing up of hundreds of amateur-built telescopes, are evidence that Mr. Ingalls has really launched a new hobby in this country. In this second edition the book has grown from 102 to 285 pages. Besides the elementary description of simple methods that made the first edition so popular, there are now a number of somewhat more advanced items, such as a description of the spectrohelioscope by Dr. George Ellery Hale, and an account of grinding machines. If you are already interested in telescope making you need this book to learn the latest wrinkles; if not, you should obtain it anyhow, and get started in this interesting work.

Astronomy—Optics
Science News-Letter, November 24, 1928

A GRAPHICAL METHOD OF PLOTTING OBLIQUE AERIAL PHOTOGRAPHS—Department of the Interior of Canada—*F. A. Acland* (*Ottawa*) (25c). A full description of the methods used by the Surveys Bureau of the Canadian Department of the Interior for mapping areas from aerial photographs. The method involves a series of glass grids on which are ruled radiating lines corresponding to parallel lines on the surface. These are checked by the actual measurements between two control points.

Aviation—Geodesy
Science News-Letter, November 24, 1928

COPRA AND COCONUT OIL—Katherine Snodgrass—*Food Research Institution, Stanford University.* This is the second in the institute's "Fats and Oils Series," and summarizes the chief facts about these important products.

Chemistry
Science News-Letter, November 24, 1928

ELEMENTARY ORGANIC CHEMISTRY—Homer Adkins and S. M. McElvain—*McGraw-Hill* ($2.25). A small, but adequate, textbook intended for a short course in organic chemistry involving fifty classroom periods.

Chemistry
Science News-Letter, November 24, 1928

INTRODUCTION TO MODERN PHYSICS—F. K. Richtmyer—*McGraw-Hill* ($5). Though there have been plenty of books in recent years on such phases of modern physics as the relativity theory, the quantum theory, the Schrödinger wave mechanics, etc., so far there has not been any really adequate view of modern physics as a whole, with all these parts fitted into their proper places. Now Professor Richtmyer has produced such a book. It is a book for anyone who wants to know the meaning of these newer ideas and their relation to the history of physics. Naturally, no book dealing with such subjects can dispense entirely with higher mathematics, but the author has made it as simple as possible. Anyone with a working knowledge of calculus can comprehend it without difficulty.

Physics
Science News-Letter, November 24, 1928

MODERN CONCEPTIONS OF ELECTRICITY—Charles R. Gibson—*Lippincott* ($5). An interestingly written book that covers somewhat more ground than its title indicates, dealing as it does with modern atomic structure, crystal analysis, relativity, spectroscopy, etc. Except for a curious confusion of Coolidge's cathode ray tube with his X-ray tube, it is quite accurate.

Physics
Science News-Letter, November 24, 1928

DIESEL ENGINE DESIGN—H. F. P. Purday—*Van Nostrand.* The development in recent years of the Diesel engine, with its application in high-powered marine units, the use of supercharging and the following of the example of gasoline engine design and successfully using it where light weight and high speed are required, have necessitated a new book on the subject. Hence this third edition of an already standard work, covering all these, and other important considerations.

Engineering
Science News-Letter, November 24, 1928

PRACTICAL AUTOMOTIVE LACQUERING—William J. Miskella—*Finishing Research Labs.* (*Chicago*) ($3.50). All about modern methods of lacquering automobiles, with full instructions, not only for small jobs, but for laying out large shops as well. The second volume in the publishers' "Practical Finishing Series."

Automotive Engineering
Science News-Letter, November 24, 1928

OUR PREHISTORIC ANCESTORS—Herdman F. Cleland—*Coward-McCann* ($5). The author of a standard text on geology has brought out an equally thoroughgoing text on early man. Various types of evidence that reveal the progress of man from the Old Stone Age down through the Age of Iron are discussed, and the early ways of living are reconstructed. Profuse illustrations depicting tools, weapons, decorative art, and monuments, as well as many charts and tables, are an outstanding feature.

Anthropology—Archæology
Science News-Letter, November 24, 1928

ANTHROPOLOGY AND MODERN LIFE—Franz Boas—*Norton* ($3). A distinguished anthropologist sets out to explain his science in everyday language, and particularly to show that understanding of the principles of anthropology illuminates the social processes of our own times and may show us what to do and what to avoid.

Anthropology
Science News-Letter, November 24, 1928

RACE AND CIVILIZATION—Friedrich Hertz—*Macmillan* ($7.50). A book close-packed with carefully annotated references to authorities; de-bunked as far as human nature permits. The author is especially rough on the Noble Nordic. His merciless objectivity spares not even his own much-advertised Teutonic race.

Ethnology
Science News-Letter, November 24, 1928

FIELD MUSEUM AND THE CHILD—*Field Museum of Natural History*—The ways in which one great museum reaches the children of its city are outlined in this pamphlet.

General Science
Science News-Letter, November 24, 1928

THE TRUTH ABOUT MIND CURE—William S. Sadler—*McClurg* ($2). That fear is responsible for much illness of mind and body is a fact gaining wider recognition. How one doctor prescribes faith as a mental medicine for such cases, and the principles of the treatment, are set forth in this small and interesting volume.

Medicine—Psychiatry
Science News-Letter, November 24, 1928

SOUTHERN COOKING—Mrs. S. R. Henrietta Stanley Dull—*Ruralist Press* ($3.50). The art of Southern cooking is reduced to a science in recipes that have been tested and revised by an expert.

Home Economics
Science News-Letter, November 24, 1928

First Glances at New Books—*Continued*

TEXAS WILD FLOWERS—Ellen D. Schulz—*Laidlaw* ($3). A compactly gotten-up book of regional botany—there should be a great deal more of this kind of work done. The author would do well, in a subsequent edition, to pay a little more attention to the quality of the photographs used for illustrations.

Botany
Science News-Letter, November 24, 1928

A KEY TO THE SPECIES OF EUCALYPTUS GROWN IN CALIFORNIA—Eric Walther—*California Academy of Sciences.* A pamphlet of interest to systematic botanists. Considering the confused state of this genus, and the difficulty non-Californians have in telling one Eucalyptus from another, the botanical profession should rise up and call the author blessed.

Botany
Science News-Letter, November 24, 1928

REPORT OF THE HARVARD BOTANICAL GARDENS, SOLEDAD ESTATE, CIENFUEGOS, CUBA (ATKINS FOUNDATION) 1900-1926—*Harvard Press* ($1.25). A summary of a quarter-century of work in an important tropical botanic garden.

Botany
Science News-Letter, November 24, 1928

A BIBLIOGRAPHY ON THE WOODS OF THE WORLD—G. P. Ahern and Helen K. Newton—*American Society of Mechanical Engineers* ($1.50). Forest Service men, wood technicians and, above all, long-suffering librarians of scientific collections will be glad to see this. It looks like a really complete job.

Forestry
Science News-Letter, November 24, 1928

TERTIARY AND PLEISTOCENE MOLLUSCA FROM THE GALAPAGOS ISLANDS, and LANDSHELLS OF THE GALAPAGOS ISLANDS—*California Academy of Sciences.* Of interest to conchologists and paleontologists. Published as part of the proceedings of the Academy.

Paleontology
Science News-Letter, November 24, 1928

MAN'S BEST FRIEND: THE STORY OF THE DOG—A. H. Trapman—*Macaulay* ($5.). This book contains a great mass of interesting anecdotal material about dogs and is excellently illustrated; but the author's great affection for his subjects prevents anything like critical objectivity in dealing with the vexed question of animal mind.

Zoology
Science News-Letter, November 24, 1928

THE CUTHBERT SELF-GUIDE—Estella Yerex Cuthbert—*Musson* (*Toronto*) ($2). A handy little guide with several convenient features, such as perforated pages containing instructions for sight-seeing routes, in the proper language, intended to be torn out and handed to the driver. Naturally, most space is given to England; none is given to Germany. The illustrations would have been better if the cuts had been made from original photographs, and not from other half-tones.

Travel
Science News-Letter, November 24, 1928

YOU AND THE LAW—S. Boyd Darling—*Appleton* ($2.50). The most likely points of contact between the average citizen and the law of the land, presented tersely in the form of a catechism.

Law
Science News-Letter, November 24, 1928

WHAT PHILOSOPHY IS—H. A. Larrabee—*Macy Masius* ($2). A short but surprisingly comprehensive survey of the various tendencies in philosophy throughout its history, supplemented with valuable reading hints and a chronological table.

Philosophy
Science News-Letter, November 24, 1928

THE CRUISE OF THE NORTHERN LIGHT—Mrs. John Borden—*Macmillan* ($4.50). Up through Bering Sea to Wrangel Island, and what kinds of folk and beasts were met with on the way. Real geography at first hand.

Geography
Science News-Letter, November 24, 1928

THIS PUZZLING PLANET—E. T. Brewster—*Bobbs Merrill* ($4). A popular account of geology, entertainingly written and very well illustrated; somewhat too sure in spots, however, and occasionally gets "jazzy".

Geology
Science News-Letter, November 24, 1928

ANTHRACITE CULM AND SILT—J. D. Sisler, T. Fraser and D. C. Ashmead—*Bureau of Publications, Harrisburg, Pa.* (50c). An exhaustive report on the problems presented by, and the present disposal of, the two chief wastes in anthracite mining.

Mining
Science News-Letter, November 24, 1928

DIESEL ENGINE RUNNING AND MAINTENANCE—Philip H. Smith—*Constable* (3/6). A practical manual telling all about Diesel engines and how to operate them.

Engineering
Science News-Letter, November 24, 1928

COLLOID SYMPOSIUM MONOGRAPH; VOL. VI—Harry Boyer Weiser, Editor—*Chemical Catalog* ($6.50). Here are collected in permanent form the papers presented at the Sixth Colloid Symposium, held at Toronto last June. The first paper is by Sir W. B. Hardy, its guest of honor, on "Living Matter," while the other 24 chapters deal with specific problems of colloid chemistry.

Chemistry
Science News-Letter, November 24, 1928

MINERALOGY—Edward Henry Kraus and Walter Fred Hunt—*McGraw-Hill* ($5). The second edition of an excellent text on minerals and crystals, with considerable revision to bring it fully up to date.

Mineralogy
Science News-Letter, November 24, 1928

CLASSICS OF SCIENCE: Redi Disproves Spontaneous Generation

Biology

The experiments here described are as easily performed today as they were two and a half centuries ago. Do not fail to appreciate (and to follow) Redi's check of his experiments with the *control flask*, covered so that the suspected flies could not enter.

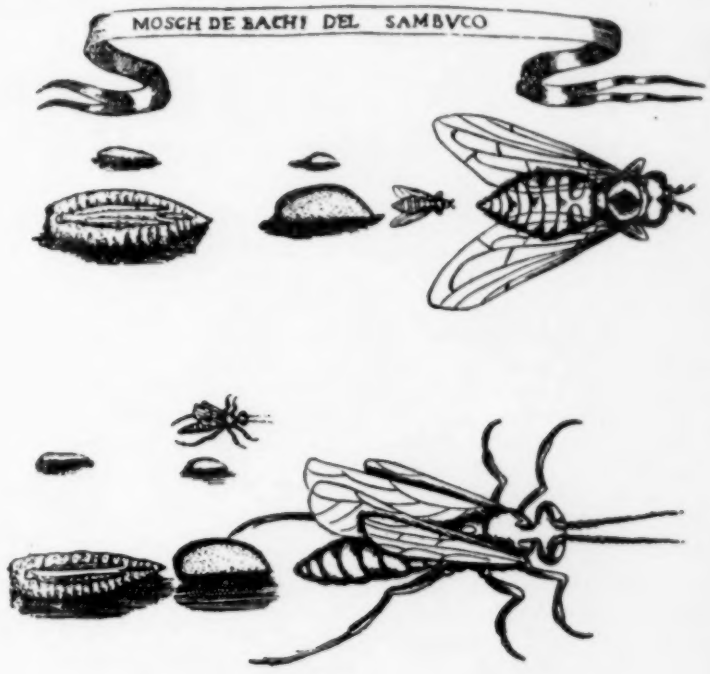
EXPERIMENTS ON THE GENERATION OF INSECTS, by Francesco Redi. Translated from the Italian Edition of 1688 *by Mab Bigelow, Chicago,* 1909. *Original: "Esperienze Intorno alla Generazione degl' Insetti", Firenze,* 1668.

Origin of Worms

Although content to be corrected by any one wiser than myself, if I should make erroneous statements, I shall express my belief that the Earth, after having brought forth the first plants and animals at the beginning by order of the Supreme and Omnipotent Creator, has never since produced any kinds of plants or animals, either perfect or imperfect; and everything which we know in past or present times that she has produced, came solely from the true seeds of the plants and animals themselves, which thus, through means of their own, preserve their species. And, although it be a matter of daily observation that infinite numbers of worms are produced in dead bodies and decayed plants, I feel, I say, inclined to believe that these worms are all generated by insemination and that the putrefied matter in which they are found has no other office than that of serving as a place, or suitable nest, where animals deposit their eggs at the breeding season, and in which they also find nourishment; otherwise I assert that nothing is ever generated therein. And, in order, Signor Carlo, to demonstrate to you the truth of what I say, I will describe to you some of those insects, which, being most common, are best known to us.

It being thus, as I have said, the dictum of ancients and moderns, and the popular belief, that the putrescence of a dead body, or the filth of any sort of decayed matter engenders worms; and being desirous of tracing the truth in the case, I made the following experiment:

At the beginning of June I ordered to be killed three snakes, the kind called eels of Æsculapius. As soon as they were dead, I placed them in an open box to decay. Not long afterwards I saw that they were covered with worms of a conical shape and apparently without legs. These worms were intent on devouring the meat, increasing meanwhile in size, and from day to day I observed that they likewise increased in number; but, although of the same shape, they differed in size, having been born on different days. But all, little and big, after having consumed the meat, leaving only the bones intact, escaped from a small aperture in the closed box, and I was unable to discover their hiding place. Being curious, therefore, to know their fate. , I again prepared three of the same snakes, which in three days were covered with small worms. These increased daily in number and size, remaining alike in form, though not in color. Of these, the largest were white outside, and the smallest ones, pink. When the meat was all consumed, the worms eagerly sought an exit, but I had closed every aperture. On the nineteenth day of the same month some of the worms ceased all movements, as if they were asleep, and appeared to shrink and gradually to assume a shape like an egg. On the twentieth day all the worms had assumed the egg shape, and had taken on a golden white color, turning to red, which in some darkened, becoming almost black. At this point the red, as well as the black ones, changed from soft to hard, resembling somewhat those chrysalides formed by caterpillars, silkworms, and similar insects. My curiosity being thus aroused, I noticed that there was some difference in shape between the red and the black eggs [pupæ],[1] though it was clear that all were formed alike of many rings joined together; nevertheless, these rings were more sharply outlined, and more apparent in the black than in the red, which last were almost smooth and without a slight depression at one end, like that in a lemon picked from its stalk, which further distinguished the black egg-like balls. I placed these balls separately in glass vessels, well covered with paper, and at the end of eight days, every shell of the red balls was broken, and from each came forth a fly of gray color, torpid and dull, misshapen as if half finished, with closed wings; but after a few minutes they commenced to unfold and to expand in exact proportion to the tiny body, which also in the meantime had acquired symmetry in all (*Turn to next page*)



WORMS AND FLIES FROM EGGS FOUND ON ELDER LEAVES. Redi says of them, "Because my brain gives me little help in describing exactly these small animals I send them to you drawn, and in their own natural size, and enlarged also by an ordinary microscope of those of only one glass."

[1]Throughout this work Redi uses the word "nova" where the context shows that pupa is meant. In this he followed Harvey, who called any embryonic mass an "egg."

Spontaneous Generation—*Continued*

its parts. Then the whole creature, as if made anew, having lost its gray color, took on a most brilliant and vivid green; and the whole body had expanded and grown so that it seemed incredible that it could ever have been contained in the small shell. Though the red eggs [pupæ] brought forth green flies at the end of eight days, the black ones labored fourteen days to produce certain large black flies striped with white, having a hairy abdomen, of the kind that we see daily buzzing about butchers' stalls. These at birth were misshapen and inactive with closed wings, like the green ones mentioned above. Not all the black eggs [pupæ] hatched after fourteen days; on the contrary, a large part of them delayed until the twenty-first day, at which time there came out some curious flies, quite distinct from the other two broods in size and form, and never before described, to my knowledge, by any historian, for they are much smaller than the ordinary house-flies. They have two silvery wings, not longer than the body, which is entirely black. The lower abdomen is shiny, with an occasional hair, as shown by the microscope, and resembles in shape that of the winged ants. The two long horns, or antennæ (a term used by writers of natural history) protrude from the head; the first four legs do not differ from those of the ordinary fly, but the two posterior ones are much larger and longer than would appear to be suitable for such a small body; and they are scaly, like the legs of the locusta marina; they are of the same color, but brighter, so red, in fact, that they would put cinnabar to shame; being all covered with white spots, they resemble fine enamel work. . . .

Are Worms Young Flies?

I continued similar experiments with the raw and cooked flesh of the ox, the deer, the buffalo, the lion, the tiger, the dog, the lamb, the kid, the rabbit; and sometimes with the flesh of ducks, geese, hens, swallows, etc., and finally I experimented with different kinds of fish, such as sword-fish, tun, eel, sole, etc. In every case, one or other of the above-mentioned kinds of flies were hatched, and sometimes all were found in a single animal. Besides these, there were to be seen many broods of small black flies, some of which were so minute as to be scarcely visible, and almost always I saw that the decaying flesh and the fissures in the boxes where it lay were covered not alone with worms, but with the eggs from which, as I have said, the worms were hatched. These eggs made me think of those deposits dropped by flies on meats, that eventually become worms, a fact noted by the compilers of the dictionary of our Academy, and also well known to hunters and to butchers, who protect their meats in Summer from filth by covering them with white cloths. . . .

The Control Experiment

Having considered these things, I began to believe that all worms found in meat were derived directly from the droppings of flies, and not from the putrefaction of the meat, and I was still more confirmed in this belief by having observed that, before the meat grew wormy, flies had hovered over it, of the same kind as those that later bred in it. Belief would be vain without the confirmation of experiment, hence in the middle of July I put a snake, some fish, some eels of the Arno, and a slice of milk-fed veal in four large, wide-mouthed flasks; having well closed and sealed them, I then filled the same number of flasks in the same way, only leaving these open. It was not long before the meat and the fish, in these second vessels, became wormy and flies were seen entering and leaving at will; but in the closed flasks I did not see a worm, though many days had passed since the dead flesh had been put in them. Outside on the paper cover there was now and then a deposit, or a maggot that eagerly sought some crevice by which to enter and obtain nourishment. . . .

Not content with these experiments, I tried many others at different seasons, using different vessels. In order to leave nothing undone, I even had pieces of meat put under ground, but though remaining buried for weeks, they never bred worms, as was always the case when flies had been allowed to light on the meat. One day a large number of worms, which had bred in some buffalo-meat, were killed by my order; having placed part in a closed dish, and part in an open one, nothing appeared in the first dish, but in the second worms had hatched, which changing as usual into egg-shape balls [pupæ], finally became flies of the common kind. In the same experiment tried with dead flies, I never saw anything breed in the closed vessel.

Hence I might conjecture that Father Kircher, though a man worthy of esteem, was led into erroneous statements in the twelfth book of "The Subterranean World," where he describes the experiment of breeding flies in the dead bodies of the same. "The dead flies," says the good man, "should be besprinkled and soaked with honey-water, and then placed on a copper-plate exposed to the tepid heat of ashes; afterwards very minute worms, only visible through the microscope, will appear, which little by little grow wings on the back and assume the shape of very small flies, that slowly attain perfect size." I believe, however, that the aforesaid honey-water only serves to attract the living flies to breed in the corpses of their comrades and to drop their eggs therein; and I hold that it is of little use to make the experiment in a copper vessel heated by warm ashes, for without these accessories the worms would have bred in the dead bodies. I also frankly confess my inability to understand how those small worms, described by Kircher, could change into small flies without at first, for the space of some days, being converted into egg-like balls [pupæ], nor how those small flies could hatch out so small and then grow larger, as all flies, gnats, mosquitoes and butterflies, as I have observed many times, on escaping from the chrysalis are of the same size that they keep through life. . . .

Francesco Redi was born in Arezzo, Tuscany, in 1626, and died in Pisa, March 1, 1697. Following his father's profession, he graduated in medicine from the University of Pisa, and settled in Florence. He became court physician to the Grand Duke, Ferdinand II, and continued under the patronage of his successor, Cosimo III. Redi, with Carlo Dati, to whom the above book is addressed, and with other scientists of his time, belonged to the Accademia del Cimento, reorganized in 1657 for the investigation of nature according to Galileo's experimental method.